CASTING AND HEAT TREATMENT OF THICK ADVANCED HIGH STRENGTH STEEL

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Introduction and Background

Advanced high strength steels (AHSS) have a unique set of properties that make them attractive for many applications, particularly in the automotive industry where higher strength and ductility allows for a reduction in component.¹ Unfortunately, current production methods limit AHSS to thin cross-sectional areas, which in turn limits their applications.² The goal of this project is to develop a steel chemistry and heat treatment in order to produce AHSS in thick (1 inch or greater) cross sections.

Experimental Procedure

A pattern was designed to produce 1 inch square cast bars. Three steel chemistries were produced from steel scrap using an induction furnace at the Kroehling Advanced Materials Foundry at Virginia Tech. For the first two chemistries, the steel scrap was melted, alloying elements were added and the metal was poured directly from the furnace into bonded sand molds. It was found that this method did not give sufficient control on the carbon content of the steel. For the third heat, the steel scrap was melted, a chemistry sample was taken, the chemistry of the steel was determined and then the amount of alloying elements was adjusted in order

to hit the target chemistry. This resulted in excellent control of the cast steel carbon content.

The heat treatment cycle required to produce a microstructure of roughly 50% ferrite/50% austenite was determined by examining the literature,³ estimating the correct temperature and then heat treating cast samples.

Results & Discussion

At present three steel chemistries have been cast and the heat treatment for each chemistry determined. The steel chemistries are listed in Table 1 and the heat treatment for each cast steel is listed in Table 2. Since we do not have the capability to perform salt bath quenching at Virginia Tech, the samples are being heat treated at Rex Heat Treat, Anniston, AL.

Future Work

Several key steps remain to be performed. Additional work will include X-ray diffraction to quantitatively determine the austenite content, optical microscopy, tensile tests to determine the yield strength, ultimate tensile strength and elongation at fracture, and hardness tests.

Table 1. Chemical Compositions of Chemistries in Wt%

	C	Si	Mn	Mo	Ni	Cu	B
Chemistry 1	0.354 ±0.009	1.85 ±0.07	1.268 ±0.015	0.102 ±0.002	1.085 ±0.028	0.082 ±0.004	0.001 ±0.0001
Chemistry 2	0.765 ±0.013	2.04 ±0.08	0.156 ±0.0024	0.025 ±0.0005	0.977 ±0.019	0.053 ±0.0023	0.001 ±0.0001
Chemistry 3	0.681 ±0.01	2.25 ±0.12	1.29 ±0.004	0.021 ±0.0007	0.889 ±0.006	0.056 ±0.0017	0.001 ±0.0001

Table 2. Proposed Heat Treatment

Step	Temperature	Time
Austenitize	1430°F	125 minutes
Austemper	675°F	90 minutes
Quench	70°F	Until Cool

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